

APPENDIX E

LEVEL OF SERVICE DESCRIPTIONS

TRAFFIC LEVELS OF SERVICE

Analysis of traffic volumes is useful in understanding the general nature of traffic in an area, but by itself indicates neither the ability of the street network to carry additional traffic nor the quality of service afforded by the street facilities. For this, the concept of *level of service* has been developed to subjectively describe traffic performance. Level of service can be measured at intersections and along key roadway segments.

Level of service categories are similar to report card ratings for traffic performance. Intersections are typically the controlling bottlenecks of traffic flow and the ability of a roadway system to carry traffic efficiently is generally diminished in their vicinities. Levels of Service A, B and C indicate conditions where traffic moves without significant delays over periods of peak travel demand. Level of service D and E are progressively worse peak hour operating conditions and F conditions represent where demand exceeds the capacity of an intersection. Most urban communities set level of service D as the minimum acceptable level of service for peak hour operation and plan for level of service C or better for all other times of the day. The *Highway Capacity Manual* provides level of service calculation methodology for both intersections and arterials.¹ The following three sections provide interpretations of the analysis approaches.

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1994 Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington D.C., 1994, Chapters 9, 10, 11.

SIGNALIZED INTERSECTIONS

For signalized intersections, level of service is evaluated based upon average vehicle delay experienced by vehicles entering an intersection. As delay increases, the level of service decreases. Calculations for signalized and unsignalized intersections are different due to the variation in traffic control. The *1994 Highway Capacity Manual* provides the basis for these calculations.

Level of Service Definitions Signalized Intersections

Level of Service	Vehicle Delay (secs.)	Description
A	≤5.00	Free Flow/Insignificant Delays: No approach phase is fully utilized by traffic and no vehicle waits longer than one red indication. Most vehicles do not stop at all. Progression is extremely favorable and most vehicles arrive during the green phase.
B	5.1-15.0	Stable Operation/Minimal Delays: An occasional approach phase is fully utilized. Many drivers begin to feel somewhat restricted within platoons of vehicles. This level generally occurs with good progression, short cycle lengths, or both.
C	15.1-25.0	Stable Operation/Acceptable Delays: Major approach phases fully utilized. Most drivers feel somewhat restricted. Higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level, and the number of vehicles stopping is significant.
D	25.1-40.0	Approaching Unstable/Tolerable Delays: The influence of congestion becomes more noticeable. Drivers may have to wait through more than one red signal indication. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. The proportion of vehicles not stopping declines, and individual cycle failures are noticeable.
E	40.1-60.0	Unstable Operation/Significant Delays: Volumes at or near capacity. Vehicles may wait through several signal cycles. Long queues form upstream from intersection. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are a frequent occurrence.
F	≥60.0	Forced Flow/Excessive Delays: Represents jammed conditions. Queues may block upstream intersections. This level occurs when arrival flow rates exceed intersection capacity, and is considered to be unacceptable to most drivers. Poor progression, long cycle lengths, and v/c ratios approaching 1.0 may contribute to these high delay levels.

Source: *Highway Capacity Manual*, Transportation Research Board. Special Report No.209 (Third Edition), Washington D.C., 1994.

UNSIGNALIZED INTERSECTIONS (Two-way Stop Controlled)

Unsignalized intersection level of service is reported for the major street and minor street (generally, left turn movements). The method assesses available and critical gaps in the traffic stream which make it possible for side street traffic to enter the main street flow. The **1994 Highway Capacity** Manual describes the detailed methodology. It is not unusual for an intersection to experience level of service E or F conditions for the minor street left turn movement. It should be understood that, often, a poor level of service is experienced by only a few vehicles and the intersection as a whole operates acceptably.

Unsignalized intersection levels of service are described in the following table.

Level of Service Definitions Unsignalized Intersections

Level of Service	Expected Delay	Avg Total Delay (Sec/Veh)
A	Little or no delay	≤ 5.0
B	Short traffic delay	5.1-10.0
C	Average traffic delays	10.1-20.0
D	Long traffic delays	20.1-30.0
E	Very long traffic delays	30.1-45.0
F	Extreme delays potentially affecting other traffic movements in the intersection	> 45

Source: **Highway Capacity Manual**, Special Report 209 (Third Edition), Transportation Research Board Washington, D.C., 1994.

ALL-WAY STOP CONTROLLED INTERSECTIONS

Unsignalized intersections and all-way stop controlled intersections are each subject to a separate capacity analysis methodology. All-way stop controlled intersection operations are reported by leg of the intersection. This method was developed by Dr. Michael Kyte of the University of Idaho.²

This method calculates a delay value for each approach to the intersection. The following table describes the amount of delay associated with each level of service.

Delay (Seconds)	Level of Service
≤ 5	A
6 - 10	B
11 - 20	
21 - 30	D
31 - 45	E
> 45	F

² *Transportation Research Circular #373*, Transportation Research Board.